Response to the PCT Written Opinion

1) Documents 1 to 4 were presented and the following opinions were expressed in the Response dated November 30, 2004 issued by the PCT International Searching Authority.

*Document 1 describes that it is necessary to make uniform the crystal condition of the inner bottom face and the crystal condition of the inner peripheral face in a hollow cathode sputtering target.

*Document 2 describes that, in addition to controlling the crystal condition of the sputtering target, it is also necessary to control the surface processing conditions, such as by polishing the surface, in order to make the film thickness uniform.

*Document 3 describes that the roughness of the erosion face of the target should be made $Ra \leqq 1.0 \mu m$ or $Ra \leqq 0.2 \mu m$ in order to make the film thickness uniform.

*Document 4 describes a clad type target.

Based on these documents, the Examiner is stating that, since it is evident that the hollow cathode sputtering target described in Document 1 makes uniform the inner bottom face and inner peripheral face of the target to be $Ra \leqq 0.5 \mu m$ from the perspective of making the film thickness uniform, claims 1 to 3, 7 and 8 do not possess inventive step. Also, since it is evident that the non-eroded portion at the outer peripheral edge is roughened, claims 4 and 5 also do not possess inventive step. Further, based on Document 4, the clad type target of claim 6 also does not possess inventive step.

2) The presented Documents 1 to 4 are as follows:

Document 1: Ryo Suzuki et al. "Development Trend of Sputtering Materials" Electronic Materials, 2002.07.01, Vol. 41, Issue 7, p.44-48, in particular page 47, left column, line 10 to right column, line 13

Document 2: Shiro Tsukamoto et al. "Reconsidering Processing Technology from Materials – Unique High-Melting Point Metals of Various Materials Viewed From Work Materials" Machine Technology, 2002.12.01, Vol. 50, Issue 13, p.60-61, in particular page 61, second line from bottom of left column to right column, line 23

Document 3: JP11-001766 (claims)

Document 4: JP 2001-098367

3) Incidentally, for the convenience of comparison with the Cited Documents, the claims are indicated once again below:

CLAIMS

1. A hollow cathode sputtering target comprising an inner bottom face having a surface roughness of Ra≦1.0 μm.

2. A hollow cathode sputtering target comprising an inner bottom face having a surface roughness of Ra≦0.5 μm.

3. The hollow cathode sputtering target according to claim 1 or claim 2, comprising a bottom face having a surface roughness Ra equal to or less than a cylindrical inner peripheral face.

4. The hollow cathode sputtering target according to any one of claims 1 to 3, comprising a rough face at the outer peripheral edge.

5. The [hollow cathode] puttering target according to claim 4, comprising a rough face formed by performing abrasive blasting to the outer peripheral edge.

6. The [hollow cathode] sputtering target according to any one of claims 1 to 5, wherein the target is formed from a cladding material.

7. A surface finishing method of a hollow cathode sputtering target of polishing and etching the bottom face of the target so as to make the surface roughness of the inner bottom face Ra≦1.0 μm.

8. A surface finishing method of a hollow cathode sputtering target of polishing and etching the bottom face of the target so as to make the surface roughness of the inner bottom face Ra≦0.5 μm.

4) Next, the present invention and Cited Documents will be compared.

Foremost, the author of Document 1 belongs to the same company as the applicant of the present application, and the Applicant is familiar with this Document 1. Foremost, we state that Document 1 has not yet led to the present invention.

With respect to the description regarding Photograph 1 in Document 1 as indicated by the Examiner, although it is true that this hollow cathode sputtering target is manufactured such that the crystal grain size and crystal orientation of A to F of Photograph 1 will be roughly the same, in reality, this is merely a general description, and the side face of a hollow cathode will be subject to ironing during the manufacture process thereof, and will have a texture that is different from the flat bottom face portion. By devising the manufacture process, the texture of the inner bottom face and peripheral face of the target can be made similar to a certain degree. Nevertheless, it is not possible to make these textures the same.

Here, a significant problem is a phenomenon unique to a hollow cathode sputtering target, which is the face that is sputtered and eroded will be limited to the inner face thereof

or, even if this is expanded, limited to the corner of the peripheral face and bottom face. This means that the bottom face of the hollow cathode sputtering target will not be eroded at all even though it faces the space where plasma is generated and occupies a large portion of the opposing area. This is something that was totally unexpected in a planar target.

This in itself is a phenomenon unique to a hollow cathode sputtering target, but other significant issues have also been discovered. That is, the sputtered substance is deposited on the bottom face that is not eroded at all, and this deposited substance will peel and cause the generation of particles. In other words, a major problem of the peeling of the redeposited film has been discovered.

This problem is not described in any way in Document 1, nor is this problem suggested anywhere therein. Therefore, present invention and Document 1 clearly have technical differences.

Generally, with a planar target, there is technology for roughening the non-eroded face in order to prevent the peeling of the redeposited film described above. Nevertheless, it has become known that this kind of roughening is not suitable for the present invention. Rather, as described in claim 1, it has been discovered that making the surface roughness of the inner bottom face $Ra \leqq 0.5 \mu m$ by polishing and etching the bottom face of the target is effective in terms of preventing the peeling of the redeposited film. It could be said that this fact in itself is a phenomenon unique to the bottom face of a hollow cathode sputtering target.

This is also not described anywhere in Document 1. Therefore, it is not possible to achieve the present invention based on Document 1, and the grounds therefore are lacking considerably.

The Examiner is stating that Document 2 describes that, in addition to controlling the crystal condition of the sputtering target, it is also necessary to control the surface processing conditions such as by polishing the surface in order to make the film thickness uniform. This, however, is referring to the erosion face to be sputtered, and is entirely different from the bottom face of the hollow cathode sputtering target which is essentially not subject to erosion, and is in the opposite situation.

Further, the diversion of a solution of a planar target to the hollow cathode sputtering target is also seriously erroneous. This is because such solution has no acknowledgement of the problems characteristic to a hollow cathode sputtering target.

The Examiner is also stating that Document 3 describes that the roughness of the erosion face of the target should be made $Ra \leqq 1.0 \mu m$ or $Ra \leqq 0.2 \mu m$ in order to make the

film thickness uniform. This is also referring to the erosion face to be sputtered, and is entirely different from the bottom face of the hollow cathode sputtering target which is essentially not subject to erosion, and relates to the opposite technology.

Therefore, the invention of independent claims 1, 2, 8 and 9 as well as dependent claims 3 to 7 that prescribes the surface roughness of the inner bottom face in a hollow cathode sputtering target to be $Ra \leqq 1.0 \mu m$ or $Ra \leqq 0.5 \mu m$, and thereby prevents the peeling of the redeposited film which causes the generation of particles from the non-eroded bottom face is not described or suggested anywhere in Documents 1 to 3.

Further, Document 4 cited by the Examiner is only common with respect to the fact that the hollow cathode sputtering target is formed from a clad plate, and the foregoing requirements are not described anywhere in this Document 4.

Therefore, it is clearly erroneous to say that the invention of claims 1 to 8 could have been easily achieved based on Documents 1 to 4.

5) Accordingly, the invention of this PCT application could not have easily been devised based on the technology described in Cited Documents 1 to 4 described above, and clearly possesses inventive step in light of the cited (conventional) technology.